TO COMPARE 0.5% BUPIVACAINE AND 0.5% ROPIVACAINE FOR COMBINED FEMORAL NERVE BLOCK AND SCIATIC NERVE BLOCK (ANTERIOR APPROACH)

Dissertation submitted in partial fulfillment of the requirements for the degree of

MD ANAESTHESIOLOGY

BRANCH - X

THE TAMIL NADU DR.M.G.R. MEDICAL UNIVERSITY

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CERTIFICATE

This is to certify that the dissertation **"TO COMPARE 0.5% BUPIVACAINE AND 0.5% ROPIVACAINE FOR COMBINED FEMORAL NERVE BLOCK AND SCIATIC NERVE BLOCK (ANTERIOR APPROACH)"** presented herein by **Dr.G.DILISH** is an original work done in the Department of Anaethesiology, Madras Medical College and Government General Hospital, Chennai for the award of MD (Branch X) Anaesthesiology under my guidance and supervision during the academic period of 2003-2006.

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CONTENTS

INTRODUCTION

Peripheral nerve blocks provide an ideal operating condition when used optimally. They are said to cause least interference with the vital physiological functions of the body with reduced stress response avoiding polypharmacy with an alert and cooperative patient when compared to the conventional techniques. Adequately administered regional anaesthesia can, not only provide very excellent intraoperative pain control but also good post operative analgesia.

Regional anaesthesia traces its origin to Dr.Carl Koller, a young viennese ophthalmologist, who in 1884 employed a solution of cocaine for topical corneal anaesthesia in patients undergoing eye surgeries. Most of the local anaesthetic agents developed between 1900 - 1940 were basically aminoester compounds. They lost their importance due to shorter duration of action, associated allergic reaction and systemic toxicity. This paved the way for the synthesis of newer agents, namely the aminoamide compounds. Subsequent newer aminomides have revolutionized the field of regional anaesthesia catering to the varying demands of modern surgery.

The advent of long acting anaesthetic drugs has made it possible to carry out prolonged surgeries in the extremities, especially in orthopaedic, vascular and plastic surgeries. The use of specific nerve blocks has additional advantage over spinal and epidural anaesthesia in that they are not associated with autonomic blockade.

Bupivacaine has been the widely used local anaesthetic drug for combined Femoral nerve block and sciatic nerve block (anterior approach) but Albright in 1979 published an alarming editorial which associated bupivacaine and etidocaine with cardic arrest. The search for a long acting local anaesthetic devoid of cardiotoxicity led to the synthesis of Ropivacaine a new amino amide local anaesthetic recently studied in adults. Its main characteristics reported to be lesser motor blockade, lesser cardiotoxicity for the same duration of analgesia in comparison to bupivacaine. The present study was designed to compare ropivacaine and bupivacaine for combined femoral nerve block and sciatic nerve block (anterior approach) in patients undergoing lower limb knee and below knee orthopaedic procedures.

AIM OF THE STUDY

The aim of study is

a. To evaluate the efficacy and safety of 0.5% Bupivacaine with 0.5% Ropivacaine for combined femoral and sciatic nerve block (anterior approach) in patients undergoing lower limb knee and below knee orthopaedic procedures with regards to.

   i. Onset of sensory and motor blockade

   ii. Duration of sensory analgesia and motor blockade

   iii. hemodynamic changes

b. To study the associated complications of the procedure.

APPLIED PHYSIOLOGY

Physiology of Nerve conduction[1]

All peripheral nerves are elongated axons of neurons situated centrally. A typical peripheral nerve consists of bundles of motor sensory and other fibres enclosed in the outermost covering called epineurium. Inside the epineurium, the perineurium surrounds the collection of bundles. Each bundle is surrounded by an endoneurium. Each nerve fibre in a bundle is enclosed in a layer of neurilemma or the axonal membrane.

Depending on the presence or absence of myelin sheath, it can be a myelinated nerve fibre or unmyelinated nerve fibre.

The axonal membrane itself is made up of a bimolecular lipid palisade, interspersed with large protein molecules. The membrane lipids are largely phospholipid composed of a polar head group and a nonpolar hydrocarbon tail.

The primary function of the cell membrane is to separate the extracellular from the intracellular environment. The major difference between these two environments is the ionic concentration; this disequilibrium provides the means for impulse conduction.

The most important ions in this respect are sodium and potassium. A membrane bound Protein $Na^{+}K^{+}$ ATPase maintains normal resting equilibrium potential between - 50 MV to - 90MV by pumping sodium ions out of the cell and potassium ions in to the cell. A positive ion gradient form inside the membrane to the outside causes electronegativity inside the membrane.

During nerve conduction the following changes occur in the cell membrane.

In the resting phase

There is a potential difference across the membrane, inside is negative, due to a higher concentration of sodium ions outside than inside the cell. The cell membrane is relatively impermeable to the sodium ions whose gradient is maintained by the sodium pump.

Depolarization phase

During excitation, sodium channels in the cell membrane open briefly allowing sodium ions to flow into the cell, thereby depolarizing the membrane.

Neutralisation Phase

During this phase, potassium ions pass out of the cell to restore electrical neutrality.

Restoration phase

During this phase, sodium ions return to the outside and potassium ions reenter the cell.

In the myelinated fibre this depolarization occurs only at the nodes of Ranvier thus giving rise to saltatory conduction of the nerve impulse thus enabling depolarization to spread rapidly.

The sodium channel is believed to be an integral membrane spanning protein. The three dimensional configuration of the protein forms a pore through the neuronal membrane.

Depolarization of the cell induces a configurational change on the sodium channel which causes it to open and allow ion passage.

Action of Local anaesthetic

The primary action produced is electrical stabilization. The large transient increase in permeability to sodium ions necessary for propagation of the impulse is prevented. Thus the resting membrane potential is maintained and depolarization in response to stimulation is inhibited.

Local anaesthetics block sodium conductance probably by dual action on the cell membrane.

1. They act directly on receptors within the sodium channels. They act probably by binding to the subunits of the sodium channel protein thereby inhibiting the conformational change in the protein during cellular depolarization.

2. They produce nonspecific membrane expansion. There is an unfolding of membrane protein together with a disordering of the lipid component of the cell membrane with consequent obstruction of the sodium channels.

APPLIED ANATOMY

The lower limb is innervated by two major nerves plexuses [2,3] namely

1. Lumbar plexus

2. Lumbosacral plexus

LUMBAR PLEXUS

Supplies Anterior, Medial and Lateral thigh, hip joint, knee joint, and anteromedial portion of leg.

LUMBOSACRAL PLEXUS

Supplies posterior part of thigh, knee joint, lateral and posterior portions of leg and whole of foot.

LUMBAR PLEXUS

Formation

The Lumbar plexus is derived from the anterior primary rami of 1st, 2nd, 3rd and part of 4th lumbar nerve roots. In 50% of the subjects, an additional contribution arises from T12.

The plexus assembles in the substance of the psoas major muscle.

L1 divides in to an upper and lower division. The upper division gives rise to the iliohypogastric and ilioinguinal nerves.

The lower division joins a branch from L2 to form the genito femoral nerve.

The rest of L2 with L3 and the contribution from L4 divide in to dorsal and ventral divisions.

Dorsal divisions of L2 and L3 form the lateral cutaneous nerve of thigh and those of L2, L3 and L4 form the femoral nerve.

The Ventral divisions join to form the obturator nerve.

LUMBO SACRAL PLEXUS IS FORMED BY:

a. Lumbo sacral trunk, ventral rami of L4 and L5.

b. Ventral rami of S1, S2, S3 and S4.

Lumbosacral trunk and the S1, S2 and S3 sacral nerves form the sciatic nerve upper band. The sciatic nerve is composed of tibial nerve and common peroneal nerve. Usually the sciatic nerve splits into these two components at the apex of popliteal fossa, but the division may occur at any level proximally.

The lower band more plexiform in arrangement, formed by the junction of S3 and portion of S4, is prolonged into the pudendal nerve.

Branches include muscular, cutaneous and visceral collateral and terminal, the sciatic and pudendal.

Cutaneous distribution of lower limb nerves

Cutaneous distribution of the lower limb nerves show considerable variation. There is a large degree of overlapping between adjacent territories.

Innervation of deep structures

It is generally assumed that muscles and bones are supplied by the same nerves as the skin overlying them.

Joints have a more complex nerve supply and receive innervation from all the nerves supplying structures around them. eg. Hip and knee joints are supplied by femoral, sciatic and obturator nerves. Ankle joint is supplied by femoral and sciatic nerves.

Course and Distribution of Nerves of Lower Limb

After formation, the branches of the lumbar plexus lie in the fascial plane between the psoas major muscle anteriorly and the iliacus muscle posteriorly forming the bed.

Femoral nerve is the largest nerve of the lumbar plexus and, in brief, supplies the muscles and the skin of the anterior compartment of the thigh. The nerve emerges from the lateral margin of psoas, passes down wards in the groove between psoas and iliacus (to both of which it sends a nerve supply), then enters the thigh beneath the inguinal ligament. At the base of the femoral triangle the nerve lies on iliacus, a finger's breadth lateral to the femoral artery. Once within the triangle the nerve breaks up in to its terminal branches which stem from an anterior and posterior division.

Anterior division

Muscular branches to:

1. Pectineus;

2. Sartorius.

Cutaneous Branches:

1. intermediate cutaneous nerve of thigh;

2. medial cutaneous nerve of thigh.

Posterior Division

Muscular branches to quadriceps femoris.

Cutaneous branch - saphenous nerve.

Articular branches to:

1. hip;

2. knee.

Obturator nerve emerges from the medial border of the psoas at the pelvic brim and crosses downward and forward in to the obturator canal. Within the canal it branches into anterior and posterior divisions and supplies medial aspect of thigh.

Lateral cutaneous nerve of the thigh emerges form the lateral border of the psoas immediately inferior to the ileo-inguinal nerve. Passing over iliacus, the nerve enters the thigh by running below the lateral extremity of the inguinal ligament and divides into an anterior and a posterior branch. The anterior branch supplies the skin over the antero-lateral aspect of the thigh down to the knee. The posterior branch penetrates the fascia lata to innervate the skin of the lateral aspect of the leg from the greater trochanter to the mid - thigh.

Sciatic nerve leaves the posterior pelvic wall through the greater sciatic foramen below piriformis and enters the region of the buttock slightly medial to the half way point between the ischial tuberosity and the greater trochanter. The nerve then descends vertically down the midline of the back of the thigh as for as the apex of the popliteal fossa. There it divides into tibial and common peroneal nerves. It supplies the back of the thigh, back of the knee joint, anterolateral and posterior aspect of leg and whole of foot and ankle joint.

Branches

The branches of the sciatic nerve can be grouped in to the following

Muscular : to semitendinosus; semimembranosus; adductor magnus; biceps femoris

Articular : to the hip joint

Terminal :

Tibial (medial popliteal) nerve

a. Muscular (to gastrocnemius, plantaris, tibialis posterior, popliteus, flexordigitorum longus and flexor hallucis longus);

b. Medial calcaneal nerve;

c. Medial plantar nerve;

d. Lateral plantar nerve;

e. Sural nerve.

Common peroneal (lateral popliteal) nerve

a. Cutaneous nerve of calf;

b. Superficial peroneal nerve;

c. Deep peroneal nerve.

TECHNIQUES OF FEMORAL AND SCIATIC NERVE BLOCK

FEMORAL NERVE BLOCK[4]

Blockade of the femoral nerve provides sensory anesthesia of the anterior thigh, knee and medial aspect of the calf, ankle and foot. A number of techniques for locating the femoral nerve exist, they are

i. Nerve stimulator technique

ii. Seeking paresthesia

iii. Loss of Resistance technique

iv. Field block

The Nerve Stimulator technique

In the nerve stimulator technique, the point of needle insertion site is 1.5 cm lateral and 1.5 cm distal to the intersection of the inguinal ligament and the femoral artery. The teflon - coated nerve stimulator needle is inserted through the skin at 45 degree angle to the skin and directed cephalad and slightly medially toward the umbilicus.A motor evoked response of movement of patella indicates stimulation of femoral nerve. After aspiration 10-15ml of Local anaesthetic is injected.

ii. Seeking paresthesia

Eliciting paresthesia provides a definite endpoint for locating the nerve, but

requires an awake and responsive patient. Paresthesia elicited during axillary brachial plexus block have been associated with neural injury and this has raised concern about use of this technique in other peripheral nerve blocks.

iii. Loss of Resistance technique

The femoral nerve lies below two facial planes: the fascia lata and the fascia iliacus. Simply feeling two successive "pops" as a short bevel regional anaesthesia needle passes through these fascial layers indicates placement of the needle in the perineural space.

iv. Field Block

When land marks are favourable, blind infiltration of local anaesthetic using multiple injections to create a "fan" across the expected route of the femoral nerve is a simple and rapid technique. The risk of intravascular injection of a single large volume of local anaesthetic is minimized by keeping the needle mobile during injection.

The femoral nerve block should be distinguished from the "three-in-one" block, the technique of lumbar plexus anaesthesia that achieves anaesthesia of the lateral femoral cutaneous and obturator as well as femoral nerves. This technique relies on a single injection of large volumes of local anesthetic (30ml or greater) within the neural "sheath" with the needle directed cephalad and the subsequent spread of anesthetic proximally aided by pressure applied distal to the femoral nerve "sheath" to achieve anesthesia of the entire lumbar plexus.

The theory behind this block presumes that the local anesthetic will track in the fascial plane between the iliacus and the psoas muscles to reach the region of the lumbar plexus roots.

Surgical anaesthesia of the entire lower extremity can be obtained when the three - in - one block is combined with the sciatic block.

Sciatic Nerve Block

The sciatic nerve can be blocked by various approaches:

i. Classic / Posterior approach - Labat

ii. Anterior approach - Beck

iii. Inferior / Lithotomy approach - Raj

iv. Lateral approach - Ichiyannagi

v. Parasacral approach - Mansour

i. Posterior approach[4]

The patient is placed in the lateral decubitus position with the side to be blocked uppermost, while the lower leg is kept straight, the ipsilateral hip and knee are flexed and a line is drawn between the greater trochanter and the posterior superior iliac spine. At the mid point, a 5cm perpendicular line is drawn caudally. These lines are referred to as Labatt's lines. A third line is drawn between the greater trochanter and sacral hiatus.

The point of injection being where the third line intersects with the second perpendicular line. After confirmatory paresthesia (or) motor evoked response (dorsiflexion (or) plantarflexion of foot) local anesthetic is injected.

ii. Anterior approach[5]

The anterior approach to block sciatic nerve is based on the fact that sciatic nerve lies just behind lesser trochanter, a bony landmark when approached form anterior aspect of thigh.

iii. Lithotomy approach[6]

With the patient supine, the ipsilateral leg is flexed 90 degrees at the knee and 90-120 degrees at the hip. A 22 gauge 3.5 to 5 inch needle is advanced at a right angle to the skin at the midpoint of a line connecting the greater trochanter and the ischial tuberosity. Local anesthetic solution is injected when paresthesia is encountered.

iv. Lateral approach[7,9]

The sciatic nerve can also be approached laterally at more than one level as it passes through the thigh. Posterior border of the greater trochanter is marked and a line is drawn parallel to the femur distally.

a. High approach

Needle entry - at the level of ischial tuberosity.

b. Mid - thigh approach

Needle entry - half way between knee and greater trochanter.

c. Low approach

Needle entry - in the gap between vastus lateralis and biceps femoris at 8cm proximal to the popliteal fossa crease.

Local anaesthetic solution is injected when motor evoked response of dorsiflexion or plantar flexion of foot is elicited.

v. Parasacral approach[8]

The parasacral approach is uniquely different from traditional sciatic nerve blocks as it blocks the root elements of sacral plexus. Patient was placed in sims position with operative site non dependent. Operative extremity was flexed 45□ at hip and 90□ at knee joint. Posterior superior iliac spine (PSIS) and Ischial tuberosity (IT) were identified. A line was drawn between PSIS and IT. 6m distal from PSIS along the same line is the point of needle entry. After motor evoked response local anaesthetic is injected.

COMPLICATIONS OF LOWER LIMB NERVE BLOCKS

1. Infection
2. Hematoma
3. Vascular puncture
4. Local anesthetic toxicity
5. Nerve injury

CONTRAINDICATIONS OF LOWER LIMB NERVE BLOCKS

Absolute

- Infection (or) hematoma in the vicinity of the puncture site
- Lesion of the nerves to be stimulated distal to the puncture site
- Patient refusal

Relative

- Neurological defecit of the leg to be anaesthetised.

ELICITED MOTOR RESPONSES FOR LOWER LIMB BLOCK[9]

Technique	Motor Response	Muscle Innervated	Nerve	Accept	Comment
Lumbar Plexus (Posterior)	Knee flexion	Hamstrings	L4 root to the sacral plexus	**x**	Too medial / too caudad
	Hip flexion	Psoas major	Direct muscle stimulation	**x**	Too deep
	Patellar twitch	Quadriceps femoris	Femoral nerve L3/4 components	—	
Femoral Nerve Block (Anterior approach)	Anterior thigh	Sartorius	Nerve to sartorius	**x**	Too superficial
	Patellar twitch	Quadriceps femoris	Femoral Nerve	—	
Sciatic Nerve Block (all approaches)	Foot plantar-flexion/ inversion	Gastrocnemius and all muscles in posterior compartment of lower leg.	Tibial nerve	—	
	Foot dorsi - flexion and eversion	Peroneal muscles	Common peroneal (fibular) nerve	—	

PHARMACOLOGY OF LOCAL ANAESTHETICS[10,11]

A local anaesthetic drug is one which reversibly blocks nerve conduction beyond the point of application, when applied locally in the appropriate concentrations.

Commonly used local anaesthetics are either aminoacyl or aminoalkyl amides. The amine group confers on the molecule, the property of a weakbase, which can combine with an acid to form a water soluble salt. This salt ionizes in solution and is usually stable. The base forms of the amide local anaesthetics are virtually insoluble in water. Hence local anesthetics are prepared commercially as hydrochloride salts and these solution have a highly acidic pH.

MECHANISM OF ACTION OF LOCAL ANAESTHETICS

When solution of local anaesthetics are deposited near the nerve, diffusion of drug molecules away from the locus is a function of:

1. Tissue binding
2. Removal from the circulation
3. Local hydrolysis of aminoester anaesthetics

Only the remaining molecules penetrate the nerve sheath.

Local anaesthetic molecules permeate the nerve axon membrane and equilibrate there and in the axoplasm. The spread and extent of these processes depend on a particular drug's pKa and the lipid solubility of the base and cation species. Binding of local anaesthetic to the site of voltage gated Na^+ channels prevents the opening of channels by inhibiting conformational changes that normally produce channel activation. Rates of onset and recovery from blockade are governed by the relatively slow diffusion of local anesthetic molecules into and out of the nerve and not by the much faster binding and dissociation to ion channels.

PHARMACODYNAMICS OF LOCAL ANAESTHETICS

Conduction blockade of a local anaesthetic is dependent on three physiochemical properties namely.

1. Lipid solubility which determines the onset of tissue penetration and potency of the drug.

2. Protein binding characteristics which determine the duration of action.

3. pKa which determines the onset time of a local anaesthetic pKa of a drug is defined as the pH at which the drug exists 50% in the ionized form and 50% in the nonionized form. The uncharged basic form of local anaesthetic is primarily responsible for diffusion across the nerve shealth, while the cationic form of the drug is responsible for the nerve blocking effect.

In general at a tissue pH of 7.4 the proportion of local anaesthetic which exists in the unionized form is inversely proportional to its pKa. Thus a drug like lignocaine with pKa of 7.74 will be 65% ionized and 35% unionized at tissue pH. On the other hand amethocaine which has a pKa of 8.6 will be 95% ionized and 5% unionized and thereby the onset of action is delayed.

PHARMACOKINETICS OF LOCAL ANAESTHETICS

Concentration of local anaesthetic in blood is determined by:

1. Rate of absorption from the site of injection.

2. Rate of distribution.

3. Rate of metabolism and excretion of the agent.

Systemic absorption of a local anaesthetic agent is determined by the site of the injection, the dosage, the addition of vasoconstrictors and the pharmacological characteristics of the agent. Eg. Lipid solubility, vasoactive properties etc.

Local anaesthetic agents are distributed throughout total body water. The distribution can be described by a 3 compartment model.

1. **Alpha phase** relates to uptake by rapidly equilibrating tissues eg. Brain and heart.

2. **Beta Phase** refers to uptake by tissues with lower perfusion e.g. Muscles and bones.

3. **Gamma Phase** is determined by the rate of metabolism and excretion of the agent.

Local Anaesthetic Toxicity

Systemic toxicity is primarily a function of plasma levels and can be altered by multiple drug's and patient factors. Toxicity usually follows intravenous injection of a large dose of local anesthetic.

The commonly used local anaesthetics are racemic mixtures of stereoisomer. Studies with bupivacaine have shown that the `R' isomer has significantly more cardiotoxicity with no increase in local anaesthetic potency and therefore its presence accounts for a significant element of the cardiovascular toxicity of bupivacaine. Ropivacaine, an analogue of bupivacaine is the optically pure S- isomer and demonstrates equivalent anaesthetic potency to bupivacaine with significantly less cardiotoxicity.

Local anaesthetic systemic toxicity is primarily manifested as a derangement of the central nervous system and the cardiovascular system.

CENTRAL NERVOUS SYSTEM

Local anaesthetics can cause both excitation and depression of the CNS depending on the plasma level. Depression of inhibitory pathways in the cerebral cortex occurs at lower plasma concentrations than those required for generalized CNS depression. This allows excitatory neurons to function in an unopposed fashion initially.

Symptoms are lightheadedness, dizziness, oro-facial numbness, visual and auditory disturbances, disorientation and drowsiness.

Signs include shivering, muscular twitching and tremors initially involving muscles of the face and distal parts of the extremities. These may progress to generalized convulsions of a tonic - clonic nature.

Comparative Central Nervous System Effects

In a study with unpremeditated, unanesthetized dogs, there was no difference in the CNS toxicity of ropivacaine and bupivacaine. The seizures were shorter with ropivacaine as compared to bupivacaine, suggesting that the clearance of ropivacaine was closer to that of bypivacaine.

Prophylaxis and Treatment of CNS toxicity

- Avoid administration of inappropriately large doses.
- Fractionation of the required bolus dose
- Early control of seizures and ventilation Significantly reduces overall mortality.

Cardiovascular system toxicity

Systemic absorption of local anesthetic agents can except direct effects on both cardiac muscle and vascular smooth muscle resulting in a broad range of effects.

1. Initial CVS stimulation stage

Hypertension

Tachycardia

2. Primary CVS depressant stage

Negative Inotropism

Decreased cardiac output

Mild - moderate hypotension

3. Secondary CVS depressant stage

Marked decrease in cardiac output

Peripheral vasodilatation

Profound hypotension

4. Terminal CVS depressant stage

Sinus bradycardia

Intracardiac conduction defects

Ventricular arrhythmias

Cardiac arrest

The aetiology of these bupivacaine induced arrhythmias is related to the prolonged inhibition of sodium conductance in the cardiac membrane. It also blocks slow calcium channels and potassium channels. Bupivacaine is 16 times as potent as lignocaine in inducing ventricular arrhythmias. Bupivacaine has been characterized as a "fast-in, slow -out" agent.

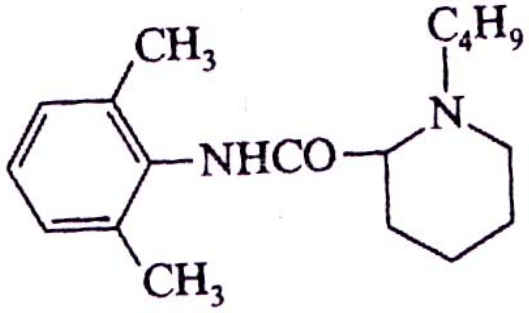
Cardiac Resuscitation

Isoprenaline 1-2 μg/min is effective in treating the bradycardia and reversing the depression of atrial and ventricular conduction caused by bupivacaine. Amrinone a phosphodiesterase inhibitor also appears to increase survival in animals treated with toxic doses of bupivacaine.

Cardiopulmonary resuscitation following collapse can be extremely difficult. Hypoxia and acidosis develop very quickly. Massive doses of cardiac stimulants and prolonged efforts at mechanical chest compression may be necessary.

PHARMACOLOGY OF BUPIVACAINE[10,11]

Bupivacaine is an aminoacyl amide synthetic local analgesic, which has been synthesized at AB Bofors by AF EKENSTAM et al. (1957). Clinically used by Telivuoin in 1963 it is produced for clinical use as a racemic mixture of the enantiomer containing equal proportions of the `S' and `R' forms.



PHYSIOCHEMICAL PROPERTIES

Bupivacaine has a butyl group on the piperidine nitrogen atom of the molecule. It is a long acting local anaesthetic drug with high anaesthetic potency. It is more lipid soluble, highly protein bound and has greater intrinsic potency. It is 3-4 times as potent as lignocaine. It crosses the placenta and the blood brain barrier.

1.	Molecular weight base	-	288
2.	pKa	-	8.1
3.	Partition coefficient	-	346
4.	Mean uptake ratio	-	3.3
5.	Protein Binding	-	96%

PHARMACOLOGICAL PROPERTIES

Onset	Moderate
Relative Potency	8
Duration	Long acting

MECHANISM OF ACTION

Bupivacaine produces electrical stimulation of the membranae by dual action on sodium conductance.

1. Acts directly on the receptors within the sodium channels.
2. Produces non - specific membrane expansion

PHARMACOLOGICAL EFFECTS

a.	Local	:	Nerve Blockade
b.	Regional	:	Pain, temperature, touch, motor power and vasomotor tone in the region supplied by the nerves are blocked.
c.	Systemic	:	Effects occurring as a result of systemic absorption or intravenous administration.

On the cardiovascular system, the effect of bupivacaine is dose related. It depresses the automaticity of the heart and myocardial contractility. Depending on the membrane potential and the rate of stimulation, bupivacaine depresses Vmax considerably more than lignocaine and results in slowed conductance of the cardiac action potential which is manifested by prolongation of the RR and QRS intervals of the electrocardiogram. This results in rentrant phenomena and ventricular arrhythmias. The sodium channels are blocked in a "fast-in, slow out" manner which causes difficulty in

resuscitation when ventricular fibrillation has occurred. The cardiotoxicity of bupivacaine results from high lipid solubility and the R-enantiomer is more toxic than S-enantiomer. Bupivacaine produced more severe arrhythmias than ropivacine in the development of ECG disturbance and severe myocardial depression was more rapid with bupivacaine than ropivacaine.

PHARMACOKINETICS

Volume of distribution at

Steady state (V^{ss})	-	73 litres
Terminal elimination □ life	-	210 minutes
Clearance	-	0.58 litres/ min
Plasma protein binding	-	96%
Metabolism	-	Liver by N-dealkylation to pipecolyloxlidine
Excretion	-	5% kidney as unchanged drug and rest as metabolites.

Preparations available

0.125%

0.25%

0.5%

Contraindications

1. Hypersensitivity : Very rare; but has been recorded
2. Intravenous regional anesthesia
3. High concentrations in obstetric patients

Mode of Use

Minor nerve block : 0.25 - 0.5%

Major nerve block : 0.25 - 0.5%

Epidural (analgesia) : 0.25 - 0.5%

Epidural (for surgery) : 0.5 - 0.75%

Spinal : 0.5%

the maximum safe dose depends on:

1. Route of administration
2. Addition of vasoconstrictor

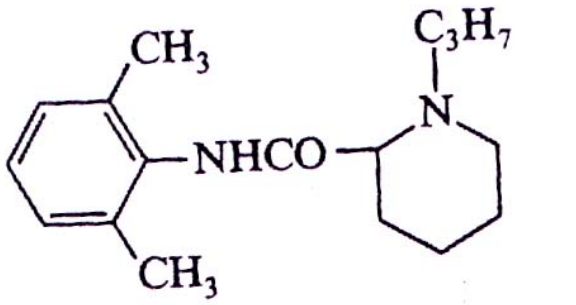
Recommended dose : 2-3mg/kg

3-4 mg/kg with adrenaline.

The addition of epinephrine will decrease plasma levels of bupivacaine in lower extremity blocks.[12]

PHARMACOLOGY OF ROPIVACAINE[10,11]

Ropivacaine is a new aminoamide local anaesthetic. It is the monohydrate of the hydrochloride salt of 1 - propyl - 2', 6' - pipecoloxylidide and is prepared as a pure S-enantiomer.



Pipecoloxylidides were first synthesized in 1957 and have been in clinical use for more than 30 years. Ropivacaine has a propyl group on the piperidine nitrogen atom of the molecule.

The pipecoloxylidides are chiral drugs because the molecules possess as asymmetric carbon atom and they may have left - (Sinister) or a right (rectus) handed configuration.

Ropivacaine is produced as the single "S" enantiomer. It has an enantiomeric purity of 99.5% and is prepared by alkylation of `S' enantiomer of dibenzoyl - L - tartaric acid.

PHYSIOCHEMICAL PROPERTIES

The physiochemical properties of Ropivacaine are as follows

1.	Molecular weight (base)	:	274
2.	pKa	:	8.1
3.	Partition coefficient (N Heptane/ buffer)	:	2.9
4.	Mean uptake ratio (rat sciatic nerve)	:	1.8
5.	Protein binding %	:	94

PHARMACOLOGIC PROPERTIES

The relative lipid solubility of ropivacaine as measured by partitioning studies between N-heptane buffer and relative mean uptake into rat sciatic nerves, shows ropivacaine to be intermediate between bupivacaine and lignocaine. Plasma - protein binding is marginally less than that of bupivacaine but the pKa is identical.

Onset	:	Moderate
Relative Potency	:	6
Duration	:	Long acting

MECHANICSM OF ACTION

Ropivacaine blocks the generation and the conduction of nerve impulses, presumably by increasing the threshold for electrical excitation in the nerve, by slowing the propagation of the nerve impulse, and by reducing the rate of rise of action potential. The progression of anaesthesia is related to the diameter, myelination and conduction velocity of affected nerve fibers.

The order of loss of nerve function clinically is as follows:

1. Pain 2. Temperature 3. Touch

4. Proprioception 5. Skeletal muscle tone

PHARMACOKINETICS

In human volunteers the pharmacokinetics characteristics of ropivacaine have bene determined after intravenous infusion.

Clearance	-	0.82 0.16 litres/min
Plasma protein binding	-	94 1%
Volume of distribution at Steady state (V^{ss})	-	59 7 litres
Terminal elimination life	-	111 62 min
Metabolism	-	Liver by aromatic hydroxylation by cytochrome P_{450}1A to 3 - hydroxy ropivacaine
Excretion	-	86% via the kidney, 1% unchanged drug, rest as metabolites.

The higher clearance of ropivacaine over bupivacaine is advantageous in terms of lesser systemic toxicity.

ABSORPTION

The systemic concentration of ropivacaine is dependent on the total dose and concentration of drug administered, the route of administration, the patient's hemodynamic condition and the vascularity of the administration site. From the epidural space, ropivacaine shows complete and biphasic absorption. The half - lives of the two phases are 14 7 minutes and 4.20.9 hrs (means S.D) respectively. The slow absorption is the rate limiting factor in the elimination of ropivacaine which is why the terminal half life is longer after epidural than after intravenous administration. Ropivacaine shows dose proportionality up to the highest intravenous dose studies, 80 mg corresponding to a mean 1.9 0.3 μg/ml.

DISTRIBUTION

After intravascular infusion, ropivacaine has a steady state volume of distribution of 59 7 litres. Ropivacaine is 94% protein bound, mainly to α_1 acid glycoprotein. An increase in total plasma concentration during continuous epidural infusion has been observed, related to postoperative increase of α_1 acid glycoprotein variations in unbound, i.e. pharmacologically active concentrations have been less than in total plasma concentrations. Ropivacaine readily crosses the placenta and rapidly equilibrium is reached in regard to unbound concentration.

METABOLISM

Ropivacaine is extensively metabolised in the liver, predominantly by aromatic hydroxylation mediated by cytochrome $P_{450}1A$ to 3- hydroxy ropivacaine. Approximately 37% of the total dose is excreted in the urine as both free and conjugated 3-hydroxy ropivacaine. Low concentrations of 3- hydroxy ropivacaine have been found in the plasma. Urinary excretion of the 4-hydroxy and both the 3-hydroxy and 4-hydroxy N-dealkylated metabolites accounts for less than 3% of the dose. An additional metabolite, 2 - hydroxy methyl ropivacaine has been identified but not quantified in the urine. Both 3-hydroxy and 4-hydroxy ropivacaine have a local anaesthetic activity in animal models less than that of ropivacaine. There is no evidence of in vivo racemization in urine of S(-) ropivacaine to R(+) ropivacaine.

ELIMINATION

The kidney is the main excretory organ for most local anaesthetic metabolites. In total, 86% of the ropivacaine dose is excreted in the urine after intravenous administration of which only 1% relates to unchanged drug. Ropivacaine has a mean total plasma clearance of 387 107 ml/min. The mean SD terminal half life is 1.8 0.7h after intravascular administration and 4.2 1.0h after epidural administration.

PHARMACODYNAMICS

Primary Pharmacodynamics (Animal Studies)

These studies showed that ropivacaine at low concentration produced a profound and rapid block of both Aδ and C fibers and was more potent than similar low concentrations of bupivacaine.

At higher concentrations, ropivacaine and bupivacaine had similar blocking properties. Aδ fibre blocking was 16% greater with bupivacaine and the degree of C fibre block was similar with both the drugs.

Ropivacaine is a potent producer of frequency (or use) dependent blocks (i.e) a block which occurs only when the fibre is stimulated Ropivacaine blocked `C' fibers faster than A fibers.

Low pKa and high lipid solubility of a local anesthetic drug favoured A over C fibre block. The lower lipid solubility of ropivacaine over bupivacaine is presumed to retard penetration into myelin sheath.

This geater degree of differential block with ropivacaine at low concentration and the property of producing frequency dependent block were considered to offer clinical advantages in providing analgesia with minimal motor block.

Secondary Pharmacodynamics

Addition of epinephrine to ropivacaine has no limiting effect on the systemic absorption of ropivacaine[13]. Systemic absorption can produce effects on the central nervous and cardiovascular systems. At blood concentrations achieved with therapeutic doses, changes in cardiac conduction, excitability, refractoriness, contractility and peripheral vascular resistance are minimal. However, toxic blood concentrations depress cardiac conduction and excitability, which may lead to atrioventricular block, ventricular arrhythmias and to cardiac arrest. In addition, myocardial contractility is depressed and peripheral vasodilation occurs, leading to decreased cardiac output and arterial blood

pressure.

Ropivacaine can produce central nervous system stimulation, depression or both. Apparent central stimulation is usually manifested as restlessness, tremors, shivering, progressing to convulsions, followed by depression and coma, progressing to respiratory arrest. However, ropivacaine has a primary depressant effect on the medulla and on higher centers. The depressed stage may occur without a prior excited stage.

IN-VIVO STUDIES

The effect of local anaesthetics on the electrophysiology of the heart has been defined. The maximal rate of increase in the cardiac action potential (V_{max}) is largely dependent on sodium ion influx via the sodium channels. All local anaesthetics are known to depress V_{max} in a dose dependent manner.

Ropivacaine is intermediate between lignocaine and bupivacaine in decreasing V_{max}. Exogenous progesterone has no additional effect on depression of V_{max}.

Ropivacaine administered by the intravenous route was found to be less toxic than bupivacaine Mild CNS symptoms and minor cardiovascular toxicity occur at lower dosage and lower plasma concentrations with bupivacaine compared with ropivacaine.

Two human volunteer studies of lumbar extradural block using 0.1%, 0.2%, or 0.3% of Ropivacaine 10ml or 0.25% Bupivacaine 10ml followed by continuous infusion of 10ml/hr of the same drug for 21 hours showed a similar spread of sensory block, reduced intensity of motor block and quick recovery which offers a distinct advantage in the clinical setting during extradural analgesia for labour or post-operative pain.

ADVERSE REACTIONS

A major cause of adverse reactions may due to excessive plasma levels which may be due to overdosage, unintentional intravascular injection or slow metabolic degradation. Most adverse events reported were mild and transient.

Central nervous system reactions

These are characterized by excitation and/or depression. Restlessness, anxiety, dizziness, tinnitus, blurred vision or tremors may occur, possibly proceeding to convulsions. However, excitement may be transient or absent with depression being the first manifestation. This may quickly be followed by drowsiness, unconsciousness and respiratory arrest. Other effects may be nausea, vomiting, chills and constriction of pupils.

Cardiovascular System Reactions

High doses of accidental intravascular injection may lead to high plasma levels and related depression of myocardium, decreased cardiac output, heart block, hypertension, bradycardia ventricular arrhythmias including ventricular tachycardia and ventricular fibrillation and possibly cardiac arrest.

Preparations available

0.2%

0.5%

0.75%

1%

Uses

1. Infiltration Anaesthesia
2. Peripheral Nerve Blocks
3. Brachial Plexus Block
4. Lumbar Extradural Block
   - Especially labour analgesia
5. Subarachnoid Block
6. Caudal Block

REVIEW OF LITERATURE

Regional anaesthesia involves the use of a local anaesthetic strategically placed along the nerve course to produce surgical anaesthesia. Bupivacaine is the most widely used local anaesthetic drug. How ever one major disadvantage of bupivacaine is its cardiac toxicity. This was recognised after numerous reports of cardiac arrest that were followed by difficult and often unsuccessful resuscitation subsequent to unintended intravascular injection of large amount of drug.

Ropivacaine is the S-enanitomer of a new amide local anaesthetic which has many of the desirable local anaesthetic effects seen with bupivacaine. Several areas of superiority for ropivacaine compared with bupivacaine have been identified, including a lower potential to produce motor blockade and a higher dose requirement to produce cardiotoxicity.

Winnie AP, Ramamurthy S. and Durrani Z (1973)[14] described the inguinal perivascular technique of lumbar plexus anaesthesia. They documented the blockade of femoral nerve, lateral cutaneous nerve of thigh and obturator nerve with a single injection and this came to be known as the 3-in-1 block.

Anker - Moller E, Dahl JB et al., (1990)[15] performed inguinal perivascular block (3-in-1 block). The three main nerves from the lumbar plexus may be blocked by injection of local anaesthetic into the fascial envelope of the femoral nerve (3-in-1 block). The femoral nerve may be localised by obtaining paresthesia, by employing a nerve stimulator or by the loss of resistance technique. They preferred the use of a nerve stimulator. The "3-in-1 block" may be employed for immediate pain relief and for treatment of postoperative pain from fractures of the hip, femur and knee.

Sansone V.De Ponti A, et al., (1999)[16] performed combined sciatic and femoral nerve block for knee arthroscopy. Selective block of the femoral and sciatic nerve was performed on 601 patients undergoing knee arthroscopy. The results were good in 87%, adequate in 12% and poor in 1%. The whole knee surface was covered by the nerve blockade. The duration of anaesthesia was 152 21 min and that of analgesia, was 336.

18 min. No correlation was observed between the effectiveness of the anaesthesia and type of surgery performed. They concluded that the technique described thus proved adequate for knee arthroscopic surgery, reproducibility was excellent, costs and hospital stays were reduced with respect to general anaesthesia, and surgeon and patient satisfaction was high.

Manani G, Angel A et al., (1982)[17] compared sciatic nerve block by the anterior and posterior approach for operations on the lower extremity. The results of the analgesia block of the lower extremity by means of an anterior (150 patients) or a posterior (114 patients) approach to the sciatic nerve, along with "3-in-1 block" were compared. The sciatic nerve block by anterior approach granted a more prolonged analgesia. They concluded that this technique was suitable for trauma patients immobilized in the supine position, for patients with skeletal traction on zupinger frame, both for surgery and for closed reduction of lower extremity fractures.

Vloka JD, Hadzic a et al., (2001)[18] studied the influence of leg rotation for the success of anterior approach to scientic nerve block. In the anterior approach for sciatic nerve block, the femur often obstructs the passage of the needle towards the sciatic nerve. They carried out the study by using human cadaver model and assessed how internal and external rotation of the leg influences the accessibility of sciatic nerve with the anterior approach. They concluded that internal rotation of the leg may significantly facilitate the needle insertion in the anterior approach to sciatic block compared to external rotation and neutral position.

McNicol LR et al., (1985)[19] performed sciatic nerve block by anterior approach for post operative pain relief in children. The technique of block differed slightly from that used in adult practice, in that great reliance was placed on the loss of resistance felt as the needle point passed through the thigh muscles into the sciatic neurovascular compartment. There were no immediate late complications associated with this block in any of the patients. It is concluded that the block is easy to perform and can produce reliable post operative analgesia for foot and ankle procedures in pediatric practice.

Luber MJ, Greengrass R et al., (2001)[20] studied the patient satisfaction and

effectiveness of Lumbar plexus and sciatic nerve block for total knee arthroplasty. Patients for study were a continuous group of 87 patients over a 1 year period. All patients were contacted by phone for a satisfaction survey. A subset of patients studied for post operative analgesia revealed an average time of 13 hrs before the first request for supplemental narcotics. They observed that there was a 92% overall satisfaction rate with the anaesthesia provided by Lumbar plexus block. They concluded that Lumbar plexus and sciatic nerve analgesia, leading to increased patient comfort and satisfaction.

Allen JG, Denny NM et al., (1998)[21] carried out a study comparing spinal anaesthesia and combined sciatic femoral 3-in-1 block for post operative analgesia following total knee arthroplasty. 39 patients studied were randomly assigned to receive either subarachnoid block (n=19) or sciatic femoral block (n=20) visual analogue pain scores and morphine requirements were recorded for 48 hrs following surgery. They observed that comparison with spinal anaesthesia, sciatic femoral block resulted in superior analgesia and reduced morphine consumption for first 24 hrs following total knee arthroplasty.

Jankowski CJ, Girsch et al., (1997)[22] compared femoral 3-in-1 block in with spinal, epidural and general anaesthesia in out patients undergoing knee arthroscopy. They found that 3-in-1 block patients had shortened hospital stay, decreased nausea and vomiting and improved post operative analgesia.

Marhofer P, Schrogendorferk et al., (1998)[23] studied combined sciatic nerve, 3-in-1 block in high risk patients. They reported on a case of combined 3-in-1 block and sciatic nerve block for amputation of lower limb in an ASA IV-V patient six days after intraoperative cardiopulmonary resuscitation following induction of general anaesthesia. Regional anaesthesia was conducted with a combination of` sciatic nerve block via posterior approach and 3-in-1 block facilitated by ultrasonographic guidance. For each of the blocks, they used 20ml of 1% mepivacaine. Sensory blockade was sufficient and patients hemodynamic and respiratory status remained stable. They concluded that this techniques is a safe method for surgery in lower limb particularly in hemodynamically unstable patients.

Pham - Dang C, Beaumonts et al., (2000)[24] reported a case of acute toxic reaction following lumbar plexus block with bupivacaine. The patient experienced ventricular dysrhythmia and seizures five minutes after the injection of 30 ml of 0.5% bupivacaine with 1 in 200,000 adrenaline following lumbar plexus block. The patient who underwent his hip arthroplasty was still anaesthetized and under controlled ventilation at the time of bupivacaine administration. Aspiration test performed before injection was negative. Normal cardiac activity and stable hemodynamic conditions were restored after 1 hour of resuscitation including 15 electric shocks and administration of 40mg epinephrine and clonidine 300 μg.

Mc Clure JH (1996)[25] in his review article on ropivacaine has stated a favourable cardiotoxic profile of ropivacacine compared with bupivacaine, confirmed in pigs. An electro physiological toxicity ratio, based on the inverse of amount of local anaesthetic agent required as 1.6:7:15 for lignocaine, ropivacaine and bupivacaine. Bupivacaine has also been found to be more cardiotoxic than equivalent doses of lignocaine or ropivacaine in isolated perfused rabbit heart (Lagendorff preparation). Bupivacaine produced more severe arrhythmias than those observed with ropivacaine, lignocaine was devoid of arhythmogenicity. The development of ECG disturbances and severe myocardial depression was more rapid with bupivacaine than ropivacaine.

Greengrass RA, Klein SM et al., (1998)[26] compared ropivacaine and bupivacaine for combined 3-in-1, sciatic nerve block for knee arthroplasty. Patients were assigned (20 per group) to receive 3-in-1 block with 30ml of local anaesthetic and sciatic nerve block using 15 ml of local anaesthetic with either 0.5% bupivacaine or 0.5% ropivacaine. All solutions contained fresh epinephrine 1:400,000. Every one minute after local anaesthetic injection, patients were assessed to determine loss of motor function and loss of pin prick sensation in the L_5-S_1 dermatomes. Time to request first analgesia was documented from PCA pump. This time was used as evidence of block regression. The mean onset time of both motor and sensory blockade was between 14 and 18 min in both groups. Duration of sensory blockade was slightly prolonged in bupivacaine (15.3 hours) than in ropivacaine group (13.2 hours). They concluded that bupivacaine 0.5% and ropivacaine 0.5% have a similar onset of motor and sensory blockade when used for

combined 3-in-1 block and sciatic nerve block. Analgesic duration from 0.5% bupivacaine was slightly prolonged compared with an equal volume of ropivacaine 0.5%.

Marhofer P et al., (2000)[27] evaluated the sensory onset time and quality of sensory block of ropivaccaine for 3-in-1 block. The sensory onset time and the quality of sensory block was assessed by pinprick test in the central sensory region of each of the 3 nerves. They found no significant differences in sensory onset time between ropivacaine group and bupivacaine group. They concluded that the sensory onset time and quality of sensory block during 3-in-1 block performed with ropivacaine are comparable to those with bupivacaine.

Beccaria P, Fanelli G et al., (1996)[28] undertook a study comparing ropivaccaine and bupivacaine during combined sciaticofemoral nerve block and found that bupivacaine had a later onset of sensory and motor blockade but a comparable duration of analgesia.

Andrea Casati et al., (1997)[29] in their study compared 0.5% bupivacaine with 0.5% ropivacaine for sciatic nerve block for Hallux valgus surgery. They concluded that 20ml of 0.5% ropivacaine and 0.5% bupivacaine produced comparable surgical block with prolonged post operative analgesia. There was no difference in the time of recovery of motor and sensory function and duration of post operative analgesia.

Mc Glade - DP, Kalpokas HV, Mooney P.H, Buckland MP et al., (1997)[30] in their study compared 0.5% bupivacaine and 0.5% ropivacaine in patients undergoing lower limb orthopaedic surgery. They compared onset time, duration of spread of sensory block, duration and degree of motor blockade and hemodynamic changes. The onset and duration of analgesia at T_{10} dermatome was 10 mins and 3.5 hours for ropivacaine and 10 minutes and 3.4 hours for bupivacaine respectively. Maximum epidural block height was T_6 for both drugs. The incidence of complete motor block was low in both groups and cardio vascular changes were similar in both groups.

Casati A, Borghi B, Fanelli G, Santorsola R et al., (2002)[31] compared 0.5% levobupivacaine and 0.5% ropivacaine for sciatic nerve block for Hallux valgus repair.

Mean onset time of surgical block at sciatic nerve distribution was 30 minutes with levobupivacaine and 15 minutes with ropivacaine. No differences in the time to recovery of sensory and motor function were observed between the two groups whereas mean duration of analgesia was 16 hours for both levobupivacaine and 0.5% ropivacaine. They concluded that 20ml of either 0.5% levobupivacaine (or) 0.5%) ropivacaine provide comparable surgical block with prolonged postoperative analgesia.

Santorsola R, Casatic A, Moizo E, Fanelli G et al., (2001)[32] compared the clinical profile of sciatic nerve block performed with either 0.5% levobupivacaine, 0.5% bupivacaine or 0.5% ropivacaine. Onset time of sciatic nerve block was 15 minutes with levobupivacaine, 30 minutes with bupivacaine and 15 minutes with ropivacaine. No differences in the quality of nerve block as well as in the nerve block resolution times were observed among the three groups. Duration of post operative analgesia was 16 hours (8-24) with levobupivacaine, 14 (8-24) hours with bupivacaine and 17 hours with ropivacaine. They concluded that 0.5% levobupivacaine for sciatic nerve block results in similar clinical effects as those produced by using the same volume and concentration of either bupivacaine and ropivacaine.

Morrison LM, Emanuelson BM et al., (1994)[33] did a study on the efficacy and kinetics of extradural ropivacaine compared with bupivacaine. They found no difference in frequency, onset, duration or spread of sensory block. However, motor block was less intense and of shorter duration with ropivacaine than bupivacaine cardiovascular changes were similar. The peak plasma concentration of ropivacaine was significantly greater and the T□ life significantly shorter. The systemic kinetics of ropivacaine were not influenced significantly by varying the concentration or volume administered.

Bader AM, Datta 5, Flanagan H, Covino BG. et al., (1989)[34] compared the in vitro potency, onset and recovery from block of ropivacaine and bupivacaine using an isolated rabbit vagus nerve. The effect of varying concentrations of ropivacaine on the compound action potential of A and C more fibres was assessed, to determine whether motor and sensory fibres have different senstivities to the two agents. The results showed that the depressent effect of bupivacaine was 16% greater than that of ropivacaine on

motor fibres, but only 3% greater on sensory fibres. Thus at the concentrations tested, ropivacaine appears to produce relatively less blockade on motor fibres than does bupivacaine but with similar sensory blockade.

Bertini L et al., (1999)[35] conducted a study comparing 0.5% ropivacaine and 0.5% bupivacaine for axillary plexus block. They demonstrated that the duration of motor block with bupivacaine was significantly longer than that of ropivacaine.

MATERIALS AND METHODS

This study was carried out in orthopaedic theater, Government General Hospital, Chennai after obtaining hospital ethical committee approval. The aim of the study was to compare the efficacy of an equal volume of two local anaesthetics, 0.5% Bupivacaine and 0.5% Ropivacaine in combined femoral nerve block and sciatic nerve block (anterior approach).

SELECTION OF CASES

40 Patients in the age group of 18-60 years belonging to ASA I and ASA II who were to undergo elective lower limb knee and below knee orthopaedic surgery were chosen. All the patients were assessed and those with normal clinical, biochemical, radiological and hematological parameters were selected. Informed written consent was obtained from all the patients. All the patients were randomly allocated in to two groups. Group B and Group R, containing 20 patients in each group.

STUDY DESIGN

The study was done in a randomized double blind fashion, patients were allocated to one of the two groups in a prospective randomized, double blinded study design Group B (n=20) received 0.5% bupivacaine with adrenaline (1:400000) and Group R received 0.5% ropivacaine with adrenaline (1:400000). The syringes containing the local anaesthetic solution were prepared in a double blinded fashion by one of the anaesthesiologist, who was not involved in further patient evaluation.

Group B - Received 0.5% Bupivacaine with adrenaline (1:400000) 15 ml for femoral nerve block and 20 ml for sciatic nerve block.

Group R - Received 0.5% Ropivacaine with adrenaline (1:400000) 15 ml for femoral nerve block and 20 ml for sciatic nerve block.

INCLUSION CRITERIA

- Assessed patients of ASA physical status I & II.
- Normal biochemical and hematological parameters.
- Age group between 18-60 years.
- No known neurological deficit.
- No local sepsis
- Informed written consent
- Weight of the patient. 70 kg (because 35 ml of local anaesthetic solution was used for blocking the nerves).

EXCLUSION CRITERIA

- Technical failure
- Patient not willing
- Neurological disorders/deformity of spine
- History of allergy to local anaesthetics
- Bleeding diathesis.

MATERIALS

Materials include IV set up for infusion and resuscitation equipments including.

Intubation set

Ventilation / oxygenation equipment

Atropine, Sedative (diazepam)

Thiopentone sodium

Succinyl choline

Vasopressor : Ephedrine

Adrenaline

Local anaesthetics

- 0.5% Bupivacaine with adrenaline (1:4,00,000)
- 0.5% Ropivacaine with adrenaline (1:4,00,000)

EQUIPMENTS

Caliper to measure sub scapular skin fold thickness.

Measuring tape for mid arm circumference, calf circumference, knee.

Height for estimating weight of non-ambulatory patients.

Prep. solution, sterile gloves

Drape

Patch electrode, Marker pen

Nerve stimulator (Fischer & Paykel) capable of delivering single twitch at $1H_Z$ with a current strength between 0.2 to 5 mA

Blunt tipped insulated nerve stimulating needle (Braun) with extension tubing for drug administration.

METHODS

Preoperative preparation

Patients were assessed preoperatively, procedure was explained to the patient and informed written consent was obtained. They were assessed with particular attention for any contraindications. Exact weight was recorded. In bed-ridden patients, approximate weight calculated from these values -knee height (KH), mid arm circumference (MAC), calf circumferences (CC) and subscapular skin fold thickness (SSF)

Weight (women) = (1.27 x CC) + (0.87 x KH) +

(0.98 x MAC) + (0.4 x SSF) - 62.35

Weight (men) = (0.98 x CC) + (1.16 X KH) + (1.73 X MAC)

+ (0.37 x SSF) - 81

Overnight fasting was advised

Assessment of pain using verbal rating scale-VRS (intra operatively) and visual analogue scale-VAS (post operatively) was explained to the patient pre-operatively.

Pre Medication

All the patients were premedicated orally with Tab. Diazepam 10mg 2 hrs before surgery.

CONDUCT OF ANAESTHESIA

On arrival of the patient in the operating room, ECG, Pulse oximetry and blood pressure base line values were recorded. After explaining the procedure to the patient an intravenous access was obtained in the dorsum of the hand and intravenous infusion of Ringer Lactate was started. Injection midazolam 2 mg I.V was given for all patients. The patients were administered femoral nerve block and sciatic nerve block by anterior approach as follows:

FEMORAL NERVE BLOCK

Positioning

Patient was positioned supine with thigh abducted 15□ on a flat surface. The inguinal region and thigh was carefully and thoroughly cleaned with povidone iodine solution and sterile drapes were placed around the site.

Land marks

Three essential land marks, the anterior superior iliac spine, pubic tubercle and femoral artery were identified.

a. Inguinal ligament: Line drawn between the anterior superior iliac spine and pubic tubercle.

b. Femoral artery just below the inguinal ligament.

Procedure

Conductive patches were attached on the ipsilateral thoracic wall and connected to the nerve stimulator.

The site of puncture for entry in to the perineural space of the femoral nerve is located approximately 1.5 cm below the inguinal ligament and 1.5 cm lateral to the femoral artery. A 2 inch 22 gauge short bevelled teflon - coated nerve stimulater needle with stimulator attached is advanced slowly at an angle of 45□ to skin, parallel to the femoral artery in a craniodorsal direction. Once the needle is through the skin the nerve stimulation output is adjusted to 1-2 mA with a frequency of 1.0 H_Z.

A motar evoked response of movement of patella indicates stimulation of femoral nerve. Once the nerve is located the needle position optimized and the stimulus intensity is adjusted downward until a patellar twitch remains present at a output of 0.2 to 0.4 mA. Through the extension tubing after negative aspiration, 15 ml of local anaesthetic solution was administered.

SCIATIC NERVE BLOCK BY ANTERIOR APPROACH OF BECK

Positioning

Patient was positioned supine, legs extended with slight internal rotation.

Land Marks

Anterior superior iliac spine, pubic tubercle, greater trochanter, lesser trochanter were identified.

Procedure

After orientation of the landmarks, a line was drawn between the anterior superior iliac spine and pubic tubercle. The line was divided into medial, middle and lateral thirds. From the junction of the medial and middle thirds, a line is drawn at a right angles caudally. A second line was drawn parallel to the first from the upper tip of the

greater trochanter across the thigh. The intersection of this line with the right angle line from the first line is marked. This point is the point of insertion of the needle for the anterior sciatic block. A 15 cm 20 G short bevel insulated nerve stimulating needle with extension tubing for drug administration is introduced at right angles to the skin through a skin wheal and was advanced in the direction of the shaft of femur. After bony contact, the needle was withdrawn slightly and redirected medially and advanced beyond the shaft of femur. At this point, the sciatic nerve is adjacent to the lesser trochanter. Nerve stimulator was attached. Stimulation frequency was set at 1 H_Z. The intensity of the stimulating current was initially set at 1-2 mA to elicit dorsiflexion on plantar flexion of the foot. After negative aspiration, 20 ml of local anaesthetic was injected.

Evaluation of the Block

The following observations were made:

1. Immediately following nerve blockade patients were evaluated every minute for first 20 minutes then every 5 minutes thereafter for sensory and motor blockade by a clinician unaware of the identity of the injected solution.

2. Time of the onset of sensory blockade was noted by testing for pinprick sensation using 26 gauge hollow needle over the area of supply of femoral and sciatic nerve seperatively and it is taken as the onset time for sensory blockade for that particular nerve.

3. The degree of motor blockade was assessed upon Bromage scale.

   0 - no motor paralysis

   1 - inability to raise extended leg

   2 - inability to flex the knee

   3 - loss of ankle dorsiflexion

   In our study motor blockade was assessed based on orthopaedic problem. For eg.

Loss of ankle dorsiflexion was assessed for problems such as fracture patella etc, and inability to flex the knee was assessed for problems in the foot.

4. The degree of pain during surgery was assessed with a 3 point verbal rating scale score (VRS)

VRS: 0 - no pain

1 - pain

2 - unbearable pain

If VRS. 1 patient received supplemental analgesia and were excluded from the study.

The quality of combined femoral nerve block and sciatic nerve block was evaluated as follows, according to the need for supplementary IV analgesia.

Satisfactory nerve block - No analgesia required to complete the surgery.

Unsatisfactory nerve block - Supplemental IV analgesia required to complete the surgery.

Failed nerve block - General anaesthesia required to complete the surgery.

Patients with unsatisfactory nerve block and failed nerve blocks were excluded from the study.

5. Vital signs monitoring using non invasive blood pressure, heart rate measured at 0,5,10,15 min and every 15 mins thereafter till one hr. 30 min and every 30 mins thereafter throughout the intraoperative procedure. ECG and SPO_2 monitored continuously. Time O for clinical assessments was the completion of anaesthetic injection at the sciatic nerve.

6. Local anaesthetic toxic reactions including subjective and objective manifestations like circumoral numbness, tinnitus, twitching, convulsion etc., if any were looked for and appropriate measures were planned.

7. Hemodynamic changes requiring anaesthesiologist's intervention (increased intravenous fluids, blood, inotropes) were looked after.

8. Duration of sensory analgesia was tested post operatively every 15 minutes using the VAS score.

9. Motor blockade was assessed every 30 minutes after the onset of motor blockade. Duration of motor blockade was taken as the time interval from the onset to the resolution of motor block.

10. Any other complications like nerve injury, hematoma or vascular injury were looked for.

PARAMETERS STUDIED

1. Onset of sensory analgesia

This is the time in minutes from the injection of the drug to the lack of appreciation of pinprick sensation.

2. Onset of motor blockade

This is the time in minutes from the time of drug injection to the loss of ankle dorsiflexion for orthopaedic problems such as fracture patella, fracture both bones leg, etc. (or) from the time of drug injection to inability to flex the knee for orthopaedic problems in the foot.

3. Duration of sensory analgesia

The duration of sensory analgesia is the time in minutes from the onset of analgesia to the time administration of rescue analgesia. Rescue analgesia was provided

with 30 mg of pentazocine intramuscularly when the VAS ≥ 4.

4. Duration of motor blockade

This is the time from the onset of motor blockade to the recovery of motor block.

All the patients included in the study were monitored postoperatively for a period of 12 hours.

OBSERVATIONS AND RESULTS

The patients included in the study were divided into two groups consisting of 18 patients each.

Group B (n = 18) received 0.5% bupivacaine

Group R (n = 18) received 0.5% ropivacaine

TABLE 1 : DISTRIBUTION OF AGE

Age in years	Group				Total
	Bupivacaine		Ropivacaine		
	Number	Percent	Number	Percent	
< 30	1	5.6	3	16.6	4
31-40	7	38.9	7	38.9	14
41-50	7	38.9	5	27.9	12
> 50	3	16.6	3	16.6	6
Total	18	100	18	100	36
Mean	41.72		40.44		t= 0.45 p= 0.67
SD	8.288		9.269		

The two groups were similar with respect to age, the difference was not statistically significant.

TABLE 2: DISTRIBUTION OF WEIGHT

Weight in Kgs	Group				Total
	Bupivacaine		Ropivacaine		
	Number	Percent	Number	Percent	
70-75	12	66.7	12	66.7	24
75-80	4	22.2	5	27.7	9
80-85	2	11.1	1	5.6	3
Total	18	100	18	100	36
Mean	74.94		74.78		t= 0.15 p= 0.89
SD	3.244		3.507		

There was no statistically significant difference between the two groups as regards weight distribution.

TABLE 3: DISTRIBUTION OF BASAL HEART RATE

Heart rate	Group				Total
	Bupivacaine		Ropivacaine		
	Number	Percent	Number	Percent	
70-75	4	22.2	6	33.3	10
76-80	7	38.9	4	22.2	11
81-85	5	27.8	6	33.3	11
86-90	2	11.1	2	11.1	4
Total	18	100	18	100	36
Mean	79.61		79.22		t= 0.24 p= 0.80
SD	4.258		5.242		

There was no statistically significant difference between the two groups as regards basal heart rate.

TABLE 4: BASAL MEAN ARTERIAL PRESSURE (MAP)

MAP	Group				Total
	Bupivacaine		Ropivacaine		
	Number	Percent	Number	Percent	
90-95	10	55.5	11	61.1	21
96-100	4	22.2	5	27.8	9
101-105	4	22.2	2	11.1	6
Total	18	100	18	100	36
Mean	96.17		95.39		t= 0.53 p= 0.59
SD	4.706		3.987		

There was no statistically significant difference between the two groups as regards basal mean arterial pressure.

TABLE 5 : DISTRIBUTION OF DURATION OF SURGERY (DOS)

DOS in mins	Group				Total
	Bupivacaine		Ropivacaine		
	Number	Percent	Number	Percent	
50-70	11	61.1	11	61.1	22
70-90	6	33.3	5	27.8	11
90-110	1	5.6	2	11.1	3
Total	18	100	18	100	36
Mean	70.00		69.39		t= 0.16 p= 0.87
SD	11.412		11.521		

There was no statistically significant difference in duration surgery between the two groups.

TABLE 6 : DISTRIBUTION OF ONSET OF MOTOR BLOCK (OOMB)

OOMB in mins	Group				Total
	Bupivacaine		Ropivacaine		
	Number	Percent	Number	Percent	
18-20	5	27.8	5	27.8	10
20-22	9	50.0	6	33.3	15
22-24	4	22.2	6	33.3	10
24-26	-	-	1	5.6	1
Total	18	100		100	36
Mean	21.28		21.64		t= 0.64 p= 0.53
SD	1.574		1.805		

There was no statistically significant difference in onset of motor blockade between the two groups.

TABLE 7 : DISTRIBUTION OF ONSET OF SENSORY BLOCKADE

FOR FEMORAL NERVE

Group	N	Mean (mins)	SD	t-test
Bupivacaine	18	13.39	1.33	t = 0.88 p = 0.39
Ropivacaine	18	13.69	0.62	

TABLE 8 : DISTRIBUTION OF ONSET OF SENSORY BLOCKADE

FOR SCIATIC NERVE

Group	N	Mean (mins)	SD	t-test
Bupivacaine	18	17.19	1.29	t = 0.13 p = 0.89
Ropivacaine	18	17.14	1.23	

The time of onset of sensory blockade was not statistically significant between the two groups.

TABLE 9: HEART RATE DURING SURGERY

Heart Rate	Group			
	Bupivacaine		Ropivacaine	
	Mean	SD	Mean	SD
0 mins	86.28	6.04	84.11	6.42
5 mins	85.44	5.56	83.61	6.15
10 mins	84.72	7.13	82.78	6.27
15 mins	84.67	5.89	83.17	5.63
30 mins	85.50	5.87	84.22	7.18
45 mins	86.33	6.23	83.61	5.74
60 mins	85.11	6.30	84.44	6.19
75 mins	85.44	5.80	83.17	6.71
90 mins	85.17	4.66	85.11	6.32
105 mins	85.17	4.06	84.61	6.55
120 mins	85.56	4.94	84.44	5.41
150 mins	85.89	5.26	84.78	6.43
180 mins	84.56	7.23	83.22	5.99

STATISTICAL ANALYSIS OF HEART RATE

Heart rate	Sum of squares	Df	Mean Square	F	P value
Within group	122.63	12	10.22	0.32	0.99
Between group	238.36	1	238.36	2.68	0.11

There was no statistically significant difference in the observed heart rate during surgery between the two groups.

TABLE 10 : MAP DURING SURGERY

MAP	Group			
	Bupivacaine		Ropivacaine	
	Mean	SD	Mean	SD
0 mins	98.67	5.83	97.89	6.12
5 mins	96.39	7.44	95.94	6.59
10 mins	95.89	4.81	94.44	7.07
15 mins	95.89	5.96	94.33	6.52
30 mins	98.00	5.52	96.61	6.25
45 mins	98.22	5.31	97.44	5.87
60 mins	98.94	4.22	98.83	5.74
75 mins	99.78	5.00	98.61	5.95
90 mins	97.72	4.99	98.28	5.57
105 mins	98.67	4.95	98.44	5.52
120 mins	99.11	4.52	99.44	5.49
150 mins	97.89	6.43	97.94	5.08
180 mins	96.06	5.99	94.78	6.80

STATISTICAL ANALYSIS OF MAP

MAP	Sum of Squares	Df	Mean Square	F	p value
Within group	990.36	12	82.53	0.88	0.28
Between group	46.80	1	46.80	0.49	0.48

There was no statistically significant difference in the observed mean arterial pressure during surgery between the two groups.

TABLE 11 : DISTRIBUTION OF DURATION OF SENSORY ANALGESIA (DOSA)

DOSA in mins	Group				Total
	Bupivacaine		Ropivacaine		
	Number	Percent	Number	Percent	
880-900	3	16.7	2	11.1	5
900-920	2	11.1	6	33.3	8
920-940	6	33.3	4	22.2	10
940-960	7	38.9	6	33.3	13
Total	18	100	18	100	36
Mean	933.67		924.22		t= 1.34 p= 0.19
SD	21.774		20.587		

Thus there was no statistically significant difference in the duration of sensory analgesia between the two groups.

TABLE 12 : DISTRIBUTION OF DURATION OF MOTOR BLOCK (DOMB)

DOMB in mins	Group				Total
	Bupivacaine		Ropivacaine		
	Number	Percent	Number	Percent	
175-200	-	-	16	88.9	16
200-225	-	-	2	11.1	2
225-250	15	83.3	-	-	15
250-275	3	16.7	-	-	3
Total	18	100	18	100	36
Mean	243.78		189.11		t= 16.86 **p = 0.001**
SD	9.564		9.887		

P<0.05 Significant

P<0.01 Highly significant

There was statistically significant difference in the duration of motor blockade between the two groups. The duration of motor blockade with bupivacaine was significantly longer than that produced by ropivacine.

DISCUSSION

Orthopaedic surgical procedure involve significant physical and emotional stress to the patients. Regional analgesia, commonly in the form of subarachnoid block or epidural analgesia have been the main stay of orthopaedic anaesthesia for lower limb orthopaedic surgeries. However, the central neuraxial anaesthesia is associated with iatrogenic complications like hypotension and urinary retention. It cannot be performed in cardiovascularly unstable patients and requires change in position of the patient and also requires change in position of the patients (Sitting or lying to one side) for administration of central neuraxial blockade, which is painful and uncomfortable to the patient who has lower limb orthopaedic problem.

Surgical anaesthesia of lower limb knee and below knee orthopaedic surgeries by combined femoral nerve block and sciatic nerve block. (anterior approach) seems to be an attractive option.

In out study, combined femoral nerve block and sciatic nerve block (anterior approach) was chosen based on the following studies.

Winnie AP et al.,[14] Anker - Moller E et al.,[15] performed 3-in-1 block by single injection of local anaesthetic into the fascial envelope of femoral nerve.

Sansone Y, Deponti A et al.,[16] performed combined sciatic and femoral nerve block for knee arthroscopy. The results were good in 87%, adequate in 12% and poor in 1%. The technique proved adequate for knee arthroscopic surgery, reproducibility was excellent, costs and hospital stays were reduced with respect to general anaesthesia, and surgeon and patient satisfaction was high.

Manani G, Angel et al.,[17] compared sciatic nerve block by anterior and posterior approach for operations on lower extremity. Sciatic nerve block by anterior approach granted a more prolonged analgesia. This technique was suitable for trauma patients immobilized in supine position, for patients with skeletal traction on Zupinger frame, both for surgery and for closed reduction of lower extremity procedures.

Luber MJ, Greengrass R et al.,[20] studied the patient satisfaction and efffectivess of combined femoral sciatic nerve block for total knee arthroscopy. It appeared to have

advantages for early postoperative analgesia , leading to increased patient comfort and satisfaction.

Allen JG, Denny NM et al.,[21] carried out a study comparing spinal anaesthesia and combined sciatic femoral 3-in-1 block for postoperative analgesia following total knee arthroplasty. They reported that, in comparison with spinal anaesthesia, sciaticofemoral block resulted in superior analgesia, reduced morphine consumptions for first 24 hours.

Marhofer P, Schrogendorferk et al.,[23] studied combined sciatic nerve and 3-in-1 block in high risk patients. They concluded that this technique is a safe method for surgery in lower limb particularly in hemodynamically unstable patients.

Pham - Dang C, Beaumont S et al.,[24] reported a case of Acute toxic accident following lumbar plexus block with bupivacaine. The patient experienced ventricular dysrythmias and seizures. Patient was resuscitated and stable hemodynamic conditions were restored after 1 hour.

Mc Clure JH[25] in his review article on ropivocaine has stated a fovourable cardiotoxic profile of ropivacaine compared with bupivacaine Bupivacaine produced more severe arrhythmias than those observed with ropivacaine. The development of ECG disturbances and severe myocardial depression was more rapid with bupivacaine than ropivacaine.

In our study, we compared 0.5% bupivacaine and 0.5% ropivacaine to determine the optimal long acting anaesthetic for combined femoral nerve block and sciatic nerve block because of the potentially improved safety profile of ropivacaine.

Patients were divided into two groups, group B and R containing 20 patients in each group, finally only 18 patients in each group were included for statistical analysis. In group B there was 1 block failure and 1 patient required supplemental analgesia. In group R 2 patients required supplemental analgesia.

Patients in both groups did not differ with respect to age distribution, sex distribution, ASA physical status, weight distribution or duration of surgery.

Onset of sensory analgesia

The onset of sensory analgesia was tested by the loss of pinprick sensation in area of supply of femoral and sciatic nerve. In our study, the time of onset of sensory analgesia was between 13 and 17 mins in both groups. The time of onset of sensory analgesia was not statistically significant between the two groups. These findings were consistent with the findings observed by Greengrass RA, Klein SM et al., [26] who observed that the mean onset time of sensory analgesia was between 14 and 18 minutes in both groups.

Marhofer P et al.,[27] demonstrated similar onset of analgesia between the bupivacaine and ropivacaine. Out study showed similar onset time of analgesia between the two groups. This correlates with the study conducted by Andrea casati et al.,[29]

Onset of motor blockade

The onset of motor blockade was assessed by bromage scale based on orthopedic problem. In our study, the time of onset of motor blockade was found to the 21.281.57 minutes for bupivacaine group and 21.64. 1.80 minutes for ropivacaine group. The difference was not statistically significant. These finding correlates with the findings made by Greengrass RA, Klein SM et al.,[26]

The onset time for motor blockade was similar between the two groups in our study. This is consistent with the studies of Andrea casati[29], Mc Glade DP, Buckland MR et al.,[30]

Duration of Sensory analgesia

The duration of sensory analgesia was 933.6721.77 minutes for group B and 924.2220.58 minutes for group R. There was no statistically significant difference in the duration of analgesia between the two groups.

The duration of sensory analgesia was found to be similar between bupivacaine and ropivacaine in the study conducted by Beccaria P et al.,[28] Andrea casati et al.,[29,31] Mc

Glade DP et al.,[30] Faneli G et al.,[31] Sanstorsola et al.,[31,32] also demonstrated comparable duration of sensory analgesia between bupivacaine and ropivacaine. In our study also, the duration of sensory analgesia was comparable between the two groups.

Duration of motor blockade

The duration of motor blockade in our study wasd 243.7̲89.56 minutes for group B and 189.1̲19.88 minutes for group R. The difference between the two groups was statistically highly significant.

These findings correlate with the findings made by Greengrass RA et al.,[26] Mc Glade DP et al.,[30] Bertini et al.,[35].

Bader et al.,[34] showed that the depressant effect of bupivacaine was 16% greater than that of ropivacaine on motor fibres and that it was statistically significant.

These findings correlate with the findings in our study which showed a lesser duration of motor blockade with ropivacaine when compared to bupivacaine.

Hemodynamics

In our study, no significant difference was observed with respect to heart rate and mean arterial pressure. This finding is consistent with Allen JG, Denny NM et al.,[21] Marhofer P et al.,[23] Mc Glade DP et al.,[30] Morrison LM[33] who concluded that there was no significant hemodynamic changes after administration of the block with bupivacaine and ropivaccaine.

Considering the literature regarding the cardiovascular and central nervous system toxicity of ropivaccaine and bupivacaine, ropivacaine seems to be less toxic than bupivacaine. Another possible mechanism for the lower toxicity of ropivacaine compared with bupivacaine could be an intrinsic vasoconstrictive activity of ropivacaine with subsequent slow plasma uptake. These are potential clinical advantages during neural blockade when large volumes of local anaesthetic are required for peripheral nerve blocks in cardiovasularly compromised patients and in those cases of inadvertent intravascular administration of local anaesthetic during peripheral nerve blockade.

SUMMARY

On comparing 0.5% bupivacaine with 0.5% ropivacaine for combined femoral nerve block and sciatic nerve block (Anterior approach), it was noted

- Onset of sensory analgesia was comparable between the two groups.
- Onset of motor blockade was similar with bupivacaine and ropivacaine.
- Duration of sensory analgesia was similar with both drugs
- Motor blockade was of significantly lesser duration with ropivacaine compared to bupivacaine.
- Both drugs did not produce significant changes in the hemodynamic parameters.
- The lower intrinsic toxicity of ropivacaine and its improved safety profile offers it an advantage over bupivacaine for combined femoral nerve block and sciatic nerve block (Anterior approach).

CONCLUSION

In conclusion, the technique of combined femoral and sciatic nerve block by anterior approach is a safe and reliable alternative to more common forms of anaesthesia for surgeries in the knee and below knee.

From this study it can be inferred that 0.5% Ropivacaine has a comparable sensory blockade, lesser duration of motor blockade and an increased safety margin over 0.5% Bupivacaine in combined femoral nerve block and sciatic nerve block.

BIBLIOGRAPHY

1. William F. Ganong. Review of Medical physiology 2001; 20:49-61.

2. Harold Ellis, Stanley Feldman. Anatomy for anaesthetists 1997; 7: 194 - 234.

3. Brown David L: An atlas of Regional Anaesthesia. (a) Lower extremity anatomy 1992; 2:87-110 (b) Local anaesthetics and regional anaesthesia equipment 1992;2:3-11.

4. C.A. Pinnock - Peripheral Nerve blockade 1996; 3:76-85.

5. Beck G.P: Anterior approach to sciatic nerve. Anaesthesiology 1963; 24:222.

6. Raj pp, Parks RI, Watson TD, et al. New single position supine approach to sciatic - femoral nerve block. Anaesthsia Analgesia 1975; 54: 489.

7. Ichiyannagi K: Sciatic nerve block: Lateral approach with the patient supine. Anaesthesiology 1959: 20:601.

8. Mansour N.Y: "Re-evaluating the sciatic nerve block - another landmark for consideration". Reg. Anesth. 18: 322-323, 1993.

9. Barry Nicholls, David conn, Alice Roberts: The Abbott Pocket guide to practical peripheral nerve blockade. October 2003: 65-85.

10. Ronald D.Miller. Pharmacology of local anaesthetics 2005; 6(1): 573-586.

11. Dimitri Voulgaropoulos and Craig M.Palmer: Local Anaesthetic Pharmacology in International Practice of Anaesthesia, Vol.2, 1996.

12. Robison C, Ray DC, McKeown DW, Buchan AS. Effect of adrenaline on plasma concentrations of bupivacaine following lower limb nerve block. British Journal of Anaesthesia 1991; 66 (2) 228 - 31.

13. Hickey R, Blanchard, J. Hoffman J, et al. Plasma concentrations of ropivacaine given with or without epinephrine for brachial plexus block. Canadian Journal of Anaesthesia 1990; 37:878 - 82.

14. Winnie AP and Ramamurthy S and Durrani Z. The inguinal paravascular technique of lumbar plexus anaesthesia. The "3-in-1 block". Anaesthesia - Analgesia 1973: 52.

15. Anker - Moller E, Dahl JB, Spansberg NL, Schultz P, Wemberg M. Inguinal Pravascular block (3-in-1 block). Ugeskr Lacger 1990 June 4:152 (23) : 1655-8.

16. Sansone, V, Deponti A, Fanelli G, Ahostoni M. Combined sciatic and femoral nerve block for knee arthroscopy: 4 years experience: Arch Orthop Trauma Surg. 1999; 119 (3-4): 163-7.

17. Manani G, Angel A, Civran E, Tegazzin V, Dal Recchio AD, Griron GP. Sciatic nerve block by the anterior and posterior approach for operations on the lower extremity. A comparative study. Acta Anesthesiology Belgium. 1982; 33(3): 183-93.

18. Vloka JD, Hadzic A, Aprile, Thys DM. Anterior approach of sciatic nerve block: the effects of leg rotation. Anaesthesia Analgesia. 2001 Feb. 92(2): 460-2.

19. McNicol LR. Sciatic nerve block for children. Sciatic nerve block by anterior approach for post operative pain relief. Anaesthesia. 1985 May : 40(5): 410-4.

20. Luber MJ, Greengrass R, Vail TP. Patient Satisfaction and effectiveness of lumber plexus and sciatic nerve block for total knee arthroplasty. J.Arthroplasty. 2001 Jan. 16(1): 17-21.

21. Allen JG, Denny NM, Oakman N.Postoperative analgesia following total knee arthroplasty: a study comparing spinal anaesthesia and combined sciatic femoral 3-in-1 block: Regional anaesthesia and Pain Medicine. 1998. Mar-Apr; 23(2): 142-6.

22. Jankowski CJ. Comparison of femoral 3-in-1 block with spinal, epidural and general anaesthesia in out patients. Anesthesiology. 2000; 141: 93 (1): 115 - 21.

23. Marhofer, P, Schrogendorfer K, Andel H, Koinig H, Girsch W, Kaprow S. Combined sciatic nerve 3-in-1 block in high risk patient. Anaesthesiol intensivmed notfallmed schmerzther. 1998 June; 33(6): 399-401.

24. Pham - Dang C, Beaumont S, Floch H, Bodin J, Winer A, Pinaud M. Acute toxic accident following lumbar plexus block with bupivacaine. Ann Fr Anesth Reanim. 2000 May; 19(5): 356-9.

25. Mc Clure J.H. ropivacaine - Review Article . British Journal of Anaesthesia 1996; 76:300-307.

26. Greengrass RA, Klein SM, D' Ercole Fj, Gleason DG, Shimer CL, Steele SM. Lumbar and sciatic nerve block for knee arthroplasty. Comparison of ropivacaine and bupivacaine. Can J Anaesth 1998 Nov; 45 (11): 1094-6.

27. Marhofer P, Oismuller C, Faryniax B, Sitzwohl C, Mayer N, Kapral S. 3-in-1 block with ropivacaine. Evaluation of sensory onset time and quality of sensory block. Anaesthesia and analgesia 2000; 90: 125-8.

28. Beccaria P, Fanelli G, Casati A. Comparison of bupivacaine and ropivacaine for combined Sciatico femoral nerve block. Anaesthesia Analgesia 1996; 87:597-600.

29. Andrea Casati, Lugea Magistris. Comparative study of 0.5% Bupivacaine with 0.5% ropivacaine for sciatic nerve block for Hallux valgus surgery. Anaesthesia Analgesia 1997: 92: 205-8.

30. Mc Glade DP, Kalpakas MV, Mooney PH, Buckland MR. Comparison of 0.5% Ropivacaine and 0.5% bupivacaine in Lumbar epidural anaesthesia for lower limb orthopaedic surgery. Anaesthesia Intensive care. 1997 June 25 (3): 262-6.

31. Casati A, Borghi B, Fanelli, G, Cerchierini E, Santorsola R, Sassoli, V, Grispigni C, Torri G. A double blinded, randomized comparison of 0.5% levobupivacaine and 0.5% ropivacaine for sciatic nerve block: Anaesthesia Analgesia. 2002 April 94(4) : 987 - 90.

32. Santorsola R, Casati, A, Cerchierini E, Moijoe, Fanelli G. Levobupivacaine for peripheral nerve blocks of lower limb: A clinical comparison with bupivacaine and ropivacaine: Minerva Anesthesiology. 2001 September, 67 (9 suppl. 1): 33-6.

33. Morrison LM., Emanuelsson BM., Mcclure H. Efficacy and kinetics of extradural ropivacaine: Comparison with bupivacaine. British Journal of anaesthesia - 1994, 72(2): 164-169.

34. Bader AM, Datta S, Flanagan H, Covino BG. Comparison of bupivacaine and ropivacaine induced conduction blockade in the isolated rabbit vagus nerve. Anaesthesia and Analgesia 1989; 68(2): 724-7.

35. Bertini L, Tagariello, V, Mancini S, Ciaschi A, Pasteraro CM, Benedetto PD, Martini 0.75% and 0.5% ropivacaine for axillary brachial plexus block: A clinical comprsion with 0.5% bupivacaine. Regional Anaesthesia and pain medicine 1999; 24(6): 514-518.

PROTOCOL

TOPIC

Comparison of 0.5% Bupivacaine and 0.5% Ropivacaine for combined femoral nerve block and sciatic nerve block (anterior approach).

OBJECTIVE

To compare the onset time, duration of sensory analgesia and motor blockade, the hemodynamic changes and also to evaluate the efficacy and safety of 0.5% Bupivacaine with 0.5% Ropivacaine for combined femoral nerve block and sciatic nerve block (anterior approach) in patients undergoing lower limb knee and below knee orthopaedic procedures.

PROCEDURE

Type of Patient	:	ASA I/II
Age	:	18-60 years
Type of Surgery	:	Lower Limb knee and below knee orthopaedic procedures
Anaesthesia	:	Combined femoral nerve block and sciatic nerve block (anterior approach)
Premedication	:	Tab. Diazepam 10mg 2 hours before surgery.

Combined femoral nerve block and sciatic nerve block (anterior approach)

	Group B	Group R
Femoral Nerve Block	15 ml	15 ml
Sciatic Nerve Block	20 ml	20 ml

IV Fluds : Ringer lactate, Normal saline

Monitors : ECG, SPO_2, NIBP.

Parameters Observed

- Onset of sensory analgesia
- Onset of motor blockade
- Duration of sensory analgesia
- Duration of Motor blockade

Exclusion criteria

- Technical failure
- Weight less than 70 kg.
- Patient not willing
- Local sepsis
- History of allergy to local anaesthetics
- Neurological disorders
- Bleeding diathesis.

Group B - Bupivacaine

S.No	Age	Sex	Weight	Duration of Surgery	Onset of Sensory Blockade		Onset of Motor Blockade	Duration Of Sensory Blockade	Duration Of Motor Blockade
					Femoral nerve	Sciatic nerve			
1	31	M	75	74	14	19	22	938	240
2	42	F	71	65	15	20.5	21	895	230
3	38	M	72	90	13	16.5	19	960	230
4	42	M	73	75	13.5	18	22	918	255
5	49	F	72	65	12.5	17	18	892	235
6	42	M	72	78	13	14.5	20	940	255
7	53	F	81	65	14	16	21.5	950	245
8	36	M	78	84	16	18.5	20.5	960	250
9	28	M	78	68	13.5	17	24	948	235
10	55	F	76	50	13.5	16	19	938	235
11	38	M	82	60	14	17	21	948	240
12	40	M	75	74	14	16.5	23	917	250
13	43	M	74	64	14	17	22	950	249
14	33	M	72	70	11	18	24	935	250
15	47	M	72	54	12	17	20	925	260
16	45	M	75	65	12	17	21	952	250
17	32	M	77	94	11	17	23	940	230
18	57	M	74	65	15	17	22	900	249

Group R - Ropivacaine

S.No	Age	Sex	Weight	Duration of Surgery	Onset of Sensory Blockade		Onset of Motor Blockade	Duration Of Sensory Blockade	Duration Of Motor Blockade
					Femoral nerve	Sciatic nerve			
1	32	F	72	72	12.5	17	22	960	189
2	50	M	73	64	14.5	19	21	905	180
3	53	M	73	92	13.5	18	19	942	200
4	35	M	72	64	13.5	15.5	19	909	185
5	52	M	71	75	14	18	23	902	190
6	40	M	70	76	14.5	15.5	23	930	185
7	32	M	75	82	14	17	19	930	190
8	36	M	78	68	13.5	17	20	945	185
9	36	M	75	65	13.5	18	24.5	945	190
10	29	F	74	60	13.5	18	20.5	942	200
11	45	M	78	50	13	16	21	890	210
12	27	M	78	74	15	17.5	24	925	175
13	40	M	71	62	13	19	24	912	180
14	43	M	80	70	13.5	16	23	928	205
15	45	M	76	62	13.5	15.5	20	919	175
16	47	M	83	65	13.5	16	21.5	950	190
17	58	M	75	94	14.5	16.5	23	892	195
18	28	M	72	54	13.5	19	22	910	180

Basal Heart Rate and Mean Arterial Pressure of Bupivacaine

S.No	Basal Heart Rate	Basal Mean Arterial Pressure
1	84	101
2	72	92
3	81	93
4	84	102
5	82	94
6	75	94
7	80	104
8	77	98
9	82	99
10	88	90
11	79	90
12	78	90
13	79	94
14	75	94
15	78	95
16	79	98
17	74	105
18	86	98

Basal Heart Rate and Mean Arterial Pressure of Ropivacaine

S.No	Basal Heart Rate	Basal Mean Arterial Pressure
1	80	95
2	72	96
3	81	93
4	84	100
5	75	94
6	82	96
7	75	98
8	74	104
9	85	95
10	79	94
11	82	90
12	80	92
13	72	90
14	71	94
15	88	99
16	84	90
17	76	102
18	86	95

Heart rate observed during various time points of surgury (Bupivacaine)

S.No	0 Mins	5 Mins	10 Mins	15 Mins	30 Mins	45 Mins	60 Mins	75 Mins	90 Mins	105 Mins	120 Mins	150 Mins	180 Mins
1	88	85	98	80	86	88	88	83	80	86	85	88	98
2	88	82	88	88	84	85	85	78	88	84	93	85	88
3	86	82	78	84	86	82	82	96	84	86	82	82	78
4	86	89	72	88	89	88	78	78	88	82	95	89	72
5	90	79	76	89	75	85	72	86	89	84	79	80	76
6	83	94	82	93	93	95	91	95	90	90	79	92	79
7	87	89	88	88	83	80	80	85	88	83	82	80	88
8	96	94	92	96	78	82	82	89	96	88	92	82	92
9	78	92	94	78	96	92	92	88	80	90	90	92	94
10	84	76	90	84	78	84	87	80	84	82	86	87	90
11	89	83	73	83	86	72	85	80	83	79	83	83	73
12	79	89	88	90	95	92	92	88	90	95	84	89	88
13	92	84	80	79	85	89	89	92	79	85	80	89	80
14	90	92	90	85	89	98	98	86	85	89	89	98	90
15	70	86	84	72	88	78	78	84	82	82	87	78	84
16	90	78	86	80	80	88	88	86	80	82	85	88	86
17	85	80	84	87	80	87	80	89	87	80	89	80	84
18	92	85	82	80	88	89	85	75	80	86	80	84	82

Heart rate observed during various time points of surgery (Ropivacaine)

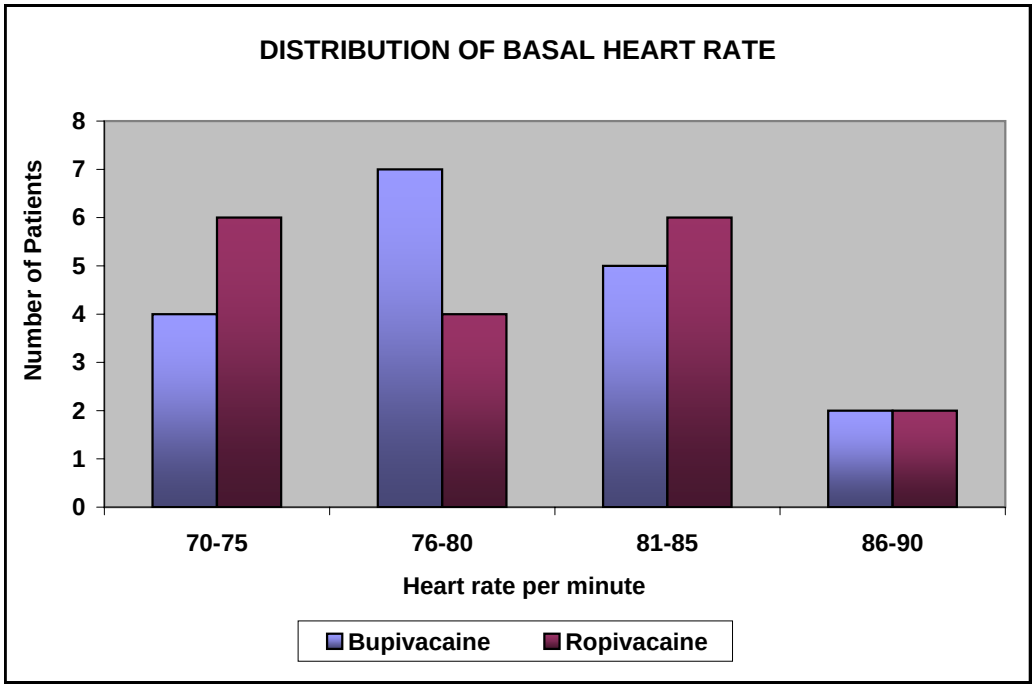
S.No	0 Mins	5 Mins	10 Mins	15 Mins	30 Mins	45 Mins	60 Mins	75 Mins	90 Mins	105 Mins	120 Mins	150 Mins	180 Mins
1	72	84	78	78	80	84	93	93	80	92	85	93	78
2	80	88	70	86	80	75	89	89	72	94	81	89	70
3	89	88	88	82	84	86	78	86	89	92	80	78	88
4	85	80	80	90	76	78	72	72	85	83	89	72	80
5	74	75	78	98	90	84	82	82	94	82	80	82	78
6	89	97	79	83	92	89	86	72	88	79	78	92	88
7	86	78	84	85	98	85	85	85	78	85	89	85	84
8	90	86	94	89	75	86	94	94	90	84	94	94	90
9	76	74	74	80	74	88	90	90	76	75	92	90	74
10	92	78	90	83	96	90	85	85	92	86	76	85	90
11	97	87	89	82	79	98	74	74	97	78	83	74	89
12	85	95	85	79	94	85	78	78	85	84	89	78	85
13	79	86	88	75	80	75	82	82	86	75	84	82	88
14	85	80	82	84	86	78	92	84	85	78	92	92	85
15	84	82	86	75	82	80	84	75	84	86	86	84	86
16	84	80	86	86	82	83	88	88	84	82	78	88	86
17	87	83	84	78	82	82	85	85	87	90	80	85	84
18	80	84	75	84	86	79	83	83	80	98	84	83	75

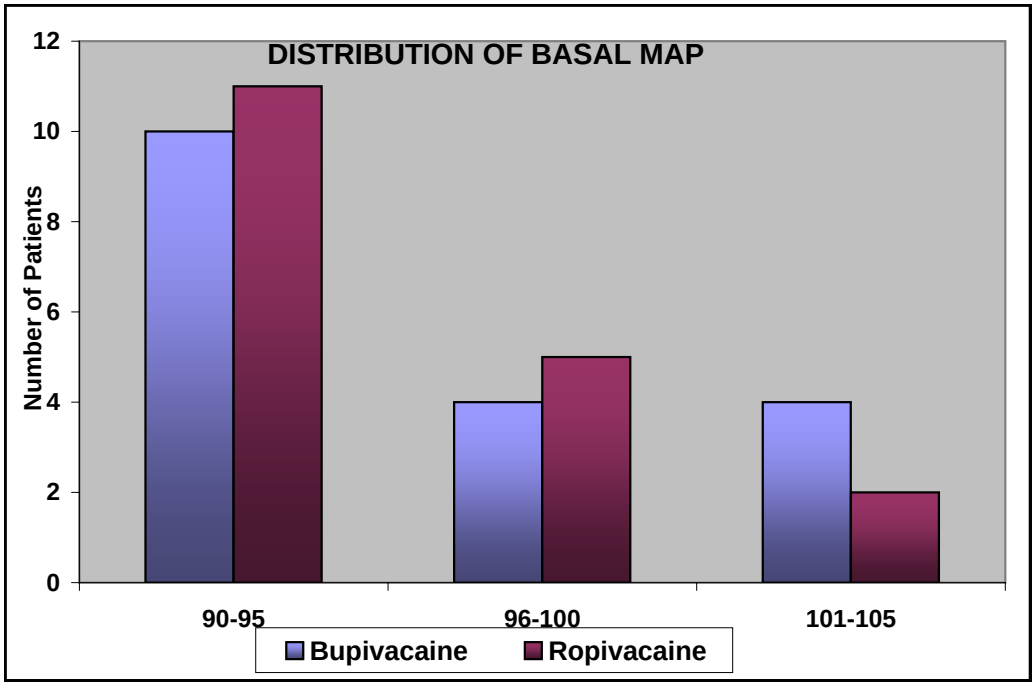
Mean Arterial Pressure observed during various time points of surgery (Bupivacaine)

S.No	0 Mins	5 Mins	10 Mins	15 Mins	30 Mins	45 Mins	60 Mins	75 Mins	90 Mins	105 Mins	120 Mins	150 Mins	180 Mins
1	94	98	97	95	97	97	97	92	105	97	102	95	98
2	99	89	86	88	91	96	96	96	91	98	104	110	88
3	110	109	102	93	105	89	98	102	106	95	103	93	104
4	92	103	93	96	95	102	102	96	90	104	104	98	98
5	108	95	103	92	101	94	105	97	99	92	102	98	94
6	104	100	92	98	104	106	105	102	100	102	100	98	102
7	102	89	91	89	91	103	103	102	98	103	95	89	92
8	102	105	101	104	96	100	100	95	99	100	93	104	108
9	95	87	98	108	91	104	104	105	97	106	95	108	92
10	105	93	99	95	92	92	92	108	96	92	98	95	90
11	95	108	92	106	96	98	102	94	97	98	106	106	105
12	102	97	102	94	105	107	94	98	107	107	98	93	96
13	98	85	89	91	89	95	95	98	92	95	91	91	87
14	89	94	94	93	101	93	98	99	102	91	95	93	94
15	91	85	94	95	101	94	99	101	98	96	98	102	90
16	98	98	93	90	107	94	94	105	95	96	105	92	96
17	94	98	101	94	99	99	94	98	95	99	96	92	95
18	98	102	99	105	103	105	103	108	92	105	99	105	100

Mean Arterial Pressure observed during various time points of surgery (Ropivacaine)

S.No	0 Mins	5 Mins	10 Mins	15 Mins	30 Mins	45 Mins	60 Mins	75 Mins	90 Mins	105 Mins	120 Mins	150 Mins	180 Mins
1	92	96	95	94	95	99	99	91	102	99	99	98	93
2	101	91	89	84	96	98	102	99	98	101	99	94	98
3	108	107	87	89	98	87	97	98	94	108	104	105	102
4	87	105	104	98	85	106	94	105	92	92	108	94	96
5	110	95	92	89	102	92	94	96	89	110	93	95	84
6	95	97	93	97	96	94	105	105	102	97	102	93	98
7	104	90	93	87	92	105	105	92	98	103	105	94	94
8	100	107	101	108	108	98	98	100	95	100	98	104	92
9	97	99	96	106	102	106	97	108	102	97	100	99	90
10	107	91	85	93	98	90	90	96	96	107	94	94	92
11	95	104	105	101	97	99	109	110	98	95	102	101	107
12	94	95	95	95	97	100	100	94	108	95	108	98	90
13	96	87	87	89	87	92	92	96	95	92	92	93	85
14	91	92	96	90	90	91	91	91	104	91	92	108	106
15	95	92	96	98	92	97	106	97	99	95	91	107	94
16	98	101	102	94	94	96	96	107	110	98	106	96	98
17	96	86	80	88	107	97	97	95	92	96	98	92	85
18	96	92	104	98	103	107	107	95	95	96	99	98	102


DISTRIBUTION OF BASAL HEART RATE
Number of Patients
8
7
6
5
4
3
2
1
0
70-75
76-80
81-85
86-90
Heart rate per minute
Bupivacaine
Ropivacaine


DISTRIBUTION OF BASAL MAP
Number of Patients
12
10
8
6
4
2
0
90-95
96-100
101-105
Bupivacaine
Ropivacaine